Decontamination of Organics in Transuranic Waste Using Silver II™

Technology Need:

Incineration, long a remediation technology of choice, is now viewed more frequently than not as a nonoption due to intervention by public interest groups. This has led the DOE to exit the incineration business and initiate the search for nonincineration alternatives. The US DOE's Savannah River Site has approximately 5000 55-gallon drums of ^{238}Pu contaminated waste in interim storage. Due to the high rate of hydrogen production resulting from the radiolysis of the organic content of the drums, these may not be shippable to WIPP in TRUPACT-II containers. In order to resolve this problem, the ^{238}Pu needs to be separated from the organics, either by mineralization of the latter or by decontamination that can perform a chemical separation.

Technology Description:

AEA Technology proposes the destruction of organic materials in transuranic waste using Silver II™ at the Savannah River Site. Silver II™ has already been demonstrated to mineralize cellulosic material, ion-exchange resins and oil to CO_2 and water, and to decontaminate the surface of polymeric materials such as PE.

Silver II™ is AEA Technology's patented process for the mineralization of a wide range of organic substrates. It has been developed over a number of years from laboratory to plant scale, culminating in the Assembled Chemical Weapons Assembly (ACWA) Program conducted on behalf of the US Army during 2000 – 2001.

At the heart of the Silver II™ process is the chemical oxidation of organic molecules by the Ag [II] ion. This is one of the most oxidizing species that can be generated at an anode in an electrochemical cell in aqueous solution. Radical species initiated by Ag[II] attack the organic substrate, progressively converting it in a series of steps irreversibly to CO_2, water and residual salts from hetero-atoms (including halides, sulfur, nitrogen and phosphorous). During the oxidation step, Ag[II] is reduced back to Ag[I]. This is then regenerated to Ag[II] again at the electrochemical anode. Because the Ag[II] is generated in-situ electrolytically, the reaction rate can be controlled by the applied current. Internal recycle of water, acid, and silver are engineered to minimize environmental discharges.

Benefits:

- It operates at ambient pressure and low temperature (20-90°C). As a result, none of the toxic or carcinogenic discharges associated with incineration (including dioxins, furans, polyaromatic hydrocarbons) are formed.

- The process has a high degree of public acceptability and regulatory permittability as a result of its inherent safety.

- The plant is self-decontaminating, due to the fact that Silver II™ dissolves the PuO_2 contaminant.

- It is a genuine waste volume reduction technology i.e. it does not generate larger volumes of less toxic waste.

- It is non-discriminatory (i.e. it will attack any organic).

- It is well proven over 16 years of development and operation.

▸It performs a very effective decontamination on those materials that it is unable to destroy completely.

▸The plant is simple and safe to operate as has been demonstrated at the Aberdeen Proving Grounds by US Army Personnel. The process operates in a continuous mode requiring a very low steady-state inventory of chemicals.

Status and Accomplishments:

AEA Technology has demonstrated that the combination of its patented SILVER II technology with ultrasonics is an effective and safe method of achieving this decontamination with DFs of 1000 being recorded on waste streams similiar to those being stored at SRS. For this cold-test phase, copper oxalate was used by SRS as a surrogate for PuO_2 contamination and this has limited chemical solubility compared to plutonium oxide.

Specifically, this work has demonstrated that

▸Irrespective of the form of the 'waste' it is possible to recover copper from all of the samples provided including surface-contaminated materials, (>98% recovery), copper encapsulated in epoxy and/or RTV cements (>90% on extended treatment) and from areas of low mass-transport (e.g. inside bottles and closed bags) (>65%).

▸Inclusion of pretreatment processes such as coarse shredding will increase these levels of 'decontamination'.

▸The action of 'decontamination' was controlled mainly by the rate of dissolution and was enhanced by using the ultrasonic/SILVER II™ combination.

▸A 'sweep' mode of ultrasonic agitation was more effective than a 'static' mode

▸Cellulosic materials and nylon were readily mineralized, while, as predicted, attack on bulk polythene, neoprene and PVC was slower - thus giving a surface decontamination effect.

The work completed has resulted in optimized process parameters for surrogate SRS waste streams and in the design and fabrication of a small scale plant for the treatment of actual SRS wastes.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 3159
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit the AEA Technology Engineering Services web site at http://www.aeat.co.uk/